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Ephraim et al.

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(54) **COFFEE DENSIFIER**

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(Continued)

(51) **Int. Cl.**

B65B 63/02 (2006.01)
A23F 5/28 (2006.01)

(Continued)

(52) **U.S. Cl.**

CPC ***B01F 7/00708*** (2013.01); ***A47J 42/36*** (2013.01); ***A47J 42/38*** (2013.01); ***A47J 42/40*** (2013.01);

(Continued)

(58) **Field of Classification Search**

CPC B30B 9/18; B30B 11/24; B30B 9/3025; B30B 9/127; B30B 9/301; B30B 11/227;

(Continued)

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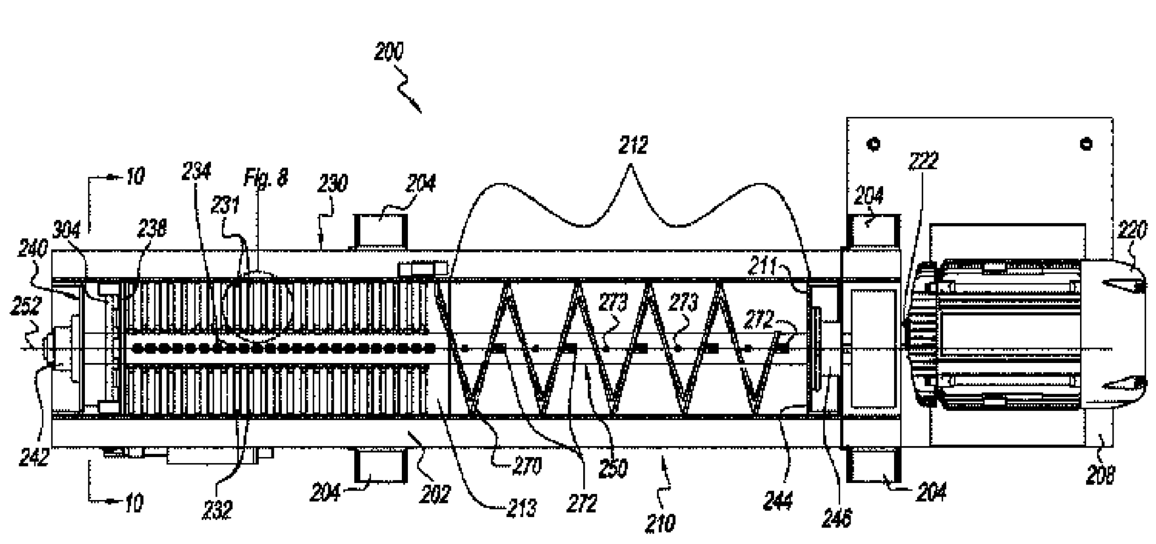
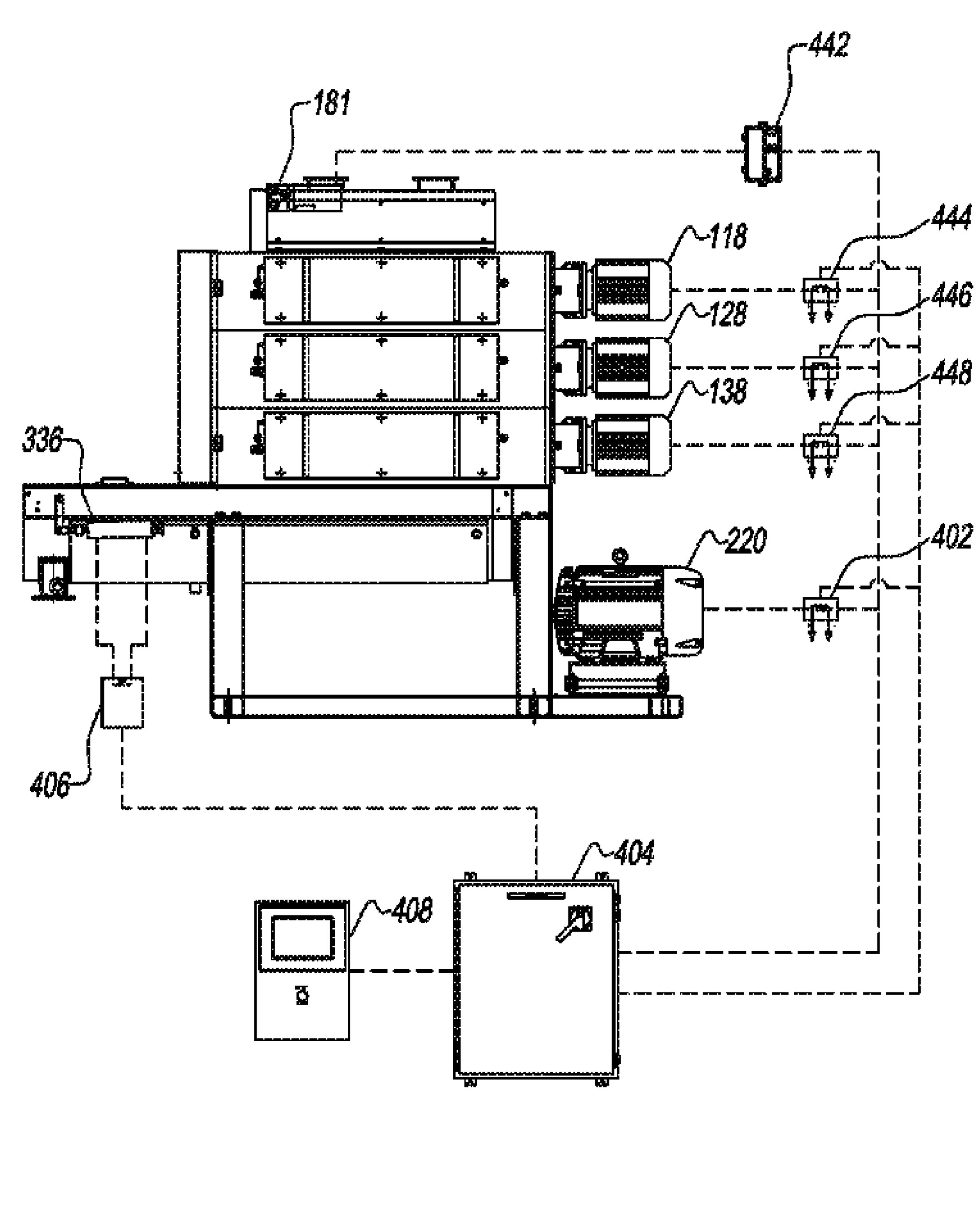
(57) **ABSTRACT**

A coffee densifier is disclosed. The coffee densifier comprises an elongated chamber, a densifier motor, a shaft, a plurality of densifier members, a discharge door actuator, a densifier motor load sensor, and a controller. The plurality of densifier members are fixed to the shaft and configured to polish a plurality of coffee particles of the ground coffee within the elongated chamber when the plurality of densifier members are rotated by the shaft through the ground coffee within the mixing chamber. The controller configured to signal the discharge door actuator to move the discharge door to increase or decrease a density of the ground coffee exiting the chamber through the discharge opening when the densifier motor load is outside a predefined densifier motor load operating range.

30 Claims, 13 Drawing Sheets





Related U.S. Application Data

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(51) **Int. Cl.**

B01F 7/00	(2006.01)
B01F 13/10	(2006.01)
B01F 15/00	(2006.01)
B01F 15/02	(2006.01)
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A47J 42/40	(2006.01)
A47J 42/44	(2006.01)
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(52) **U.S. Cl.**

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CPC B30B 11/241; B01F 7/00708; B01F 7/00141; B01F 7/00258; B01F 3/18; B01F 15/0251; B01F 13/1047; B01F 7/001; B01F 13/1002; B01F 15/00201; B01F 2013/1086; B02C 18/2258; B02C 18/2216; B02C 18/24; A23F 5/28; B65B 63/02

See application file for complete search history.

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P3: User manual for the 201/2500 post-densifier (allegedly); from EPO Opposition.

P4: Complete drawing for the 201/2500 post-densifier (allegedly); from EPO Opposition.

P5: Parts list for the complete drawing of P4 (allegedly); from EPO Opposition.

P6: Individual part drawing regulation for the post-densifier from P4 (allegedly); from EPO Opposition.

P7: Parts list for the individual part drawing of P6 (allegedly); from EPO Opposition.

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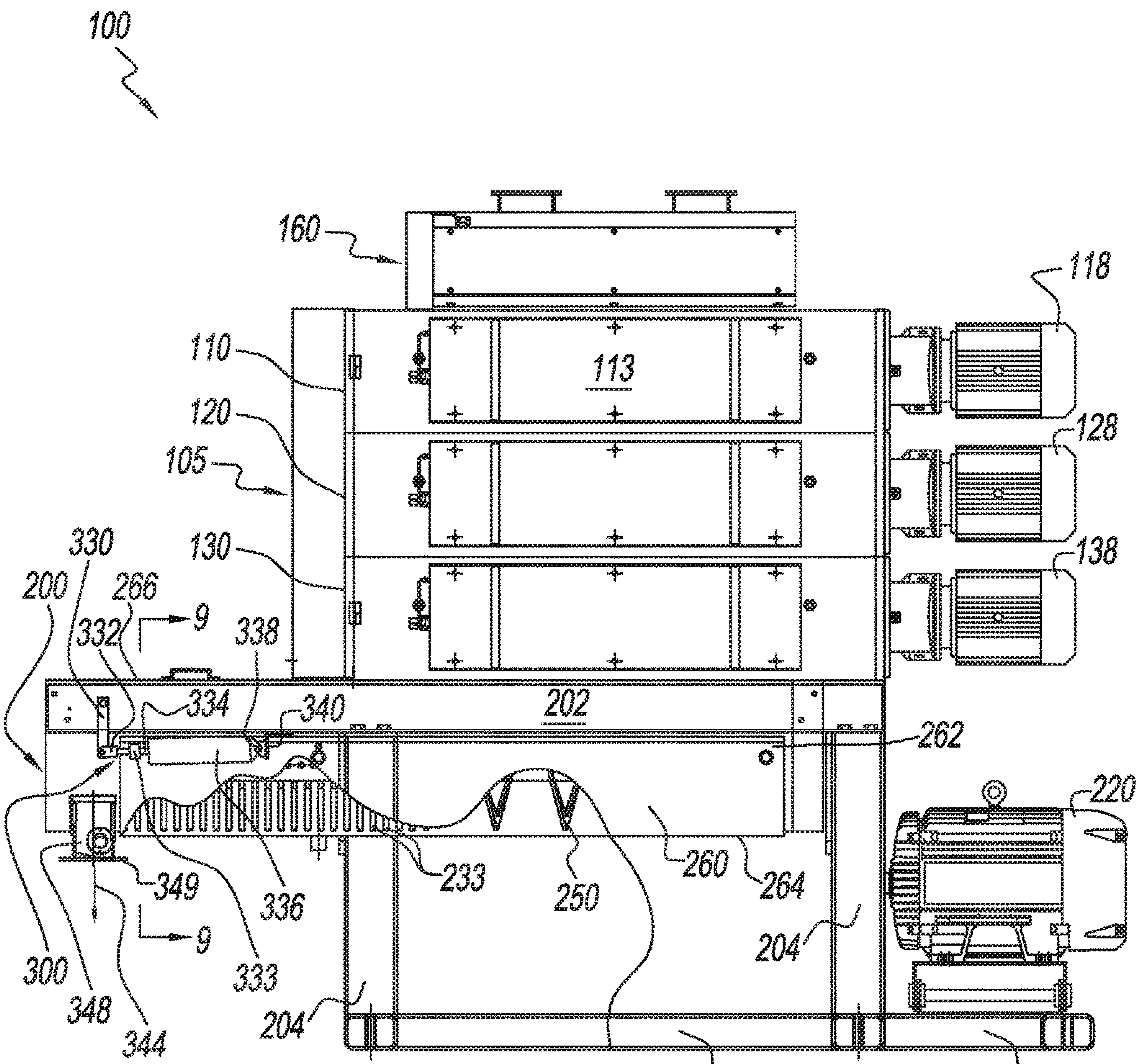
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118
110
113
120
128
105
130
138
330
200
266
9
332
338
334
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202
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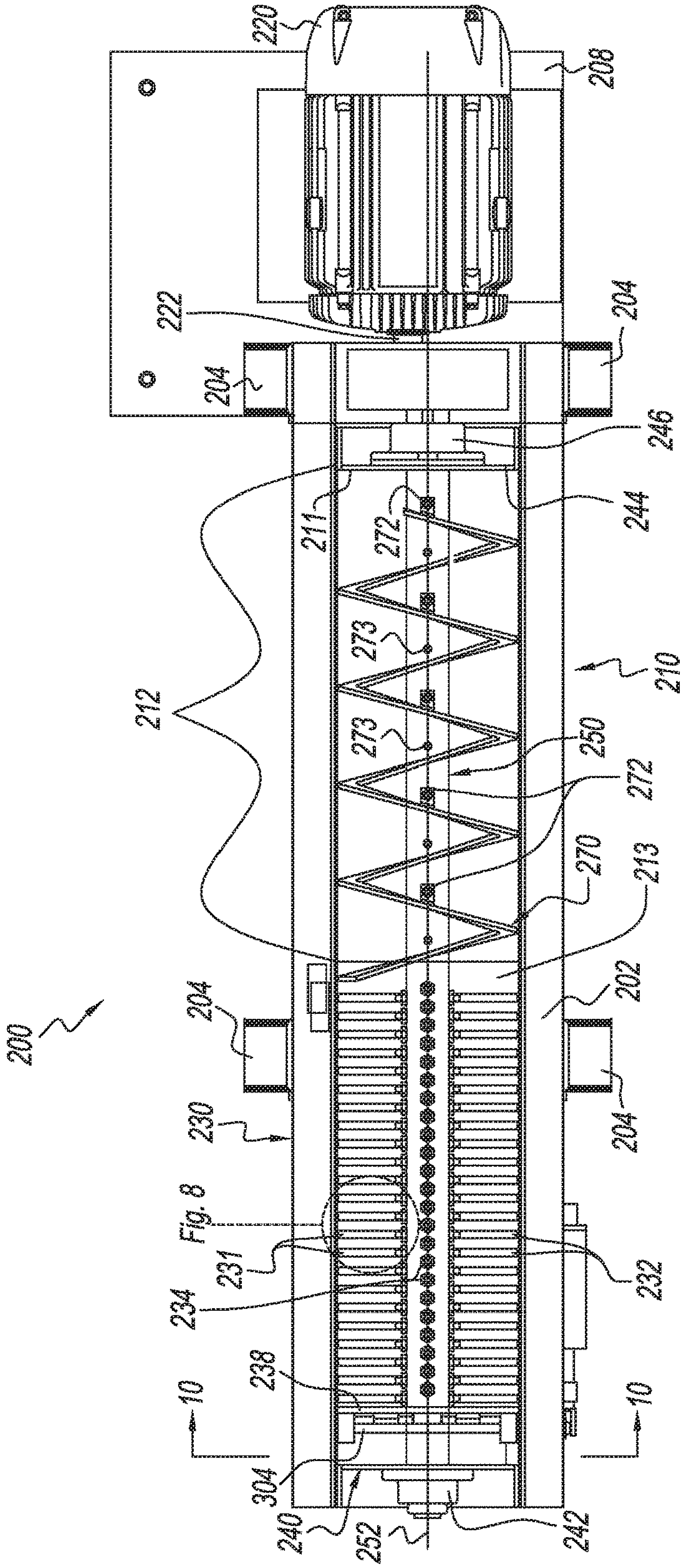
250
260
264
349
336
204
9
300
333
348
204
344
206
208

FIG. 1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273
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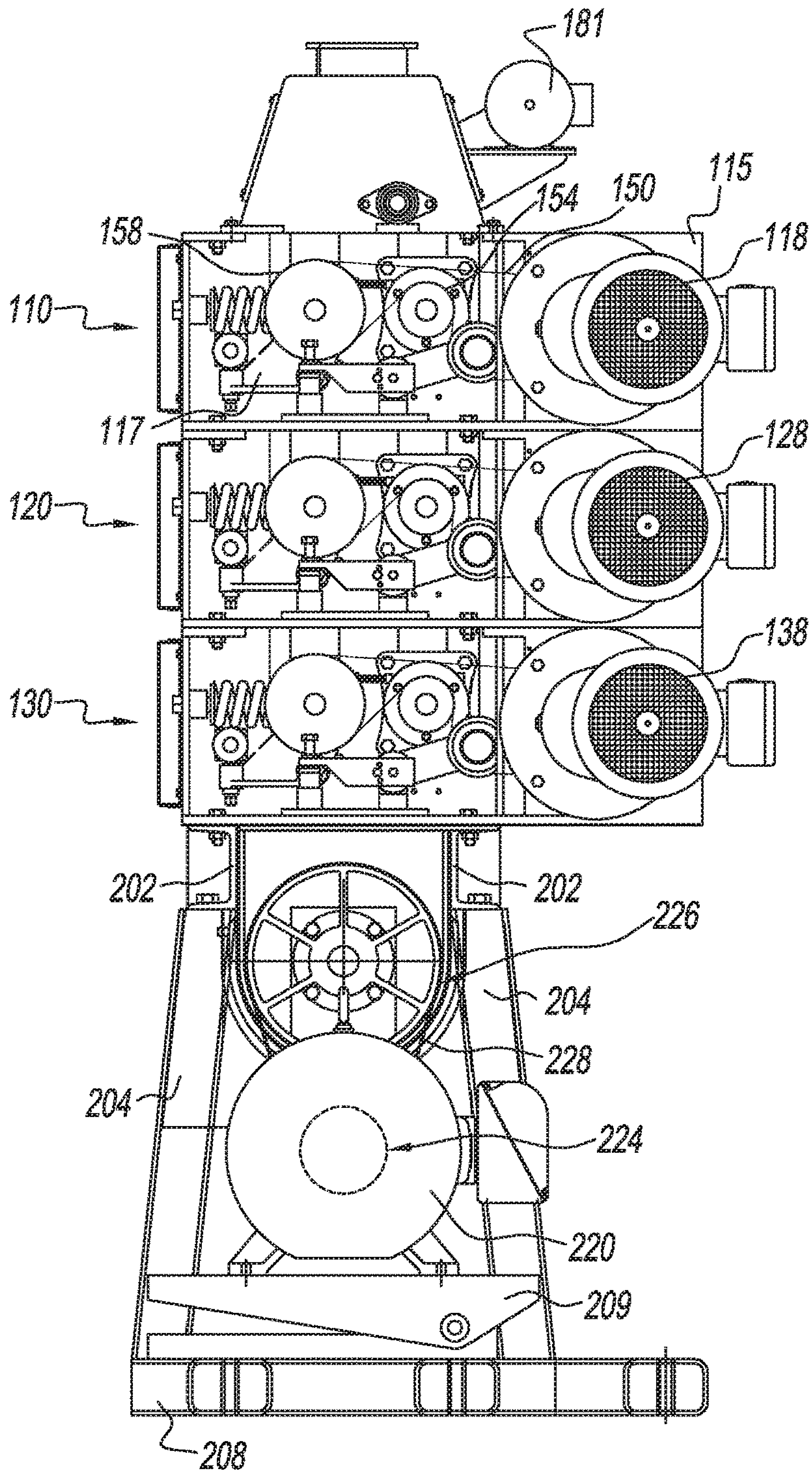
204
230
Fig. 8
231
232
234
238
10
10
304
240
252
242

FIG. 2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154
150
115
158
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138
202
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228
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224
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209
208

FIG. 3

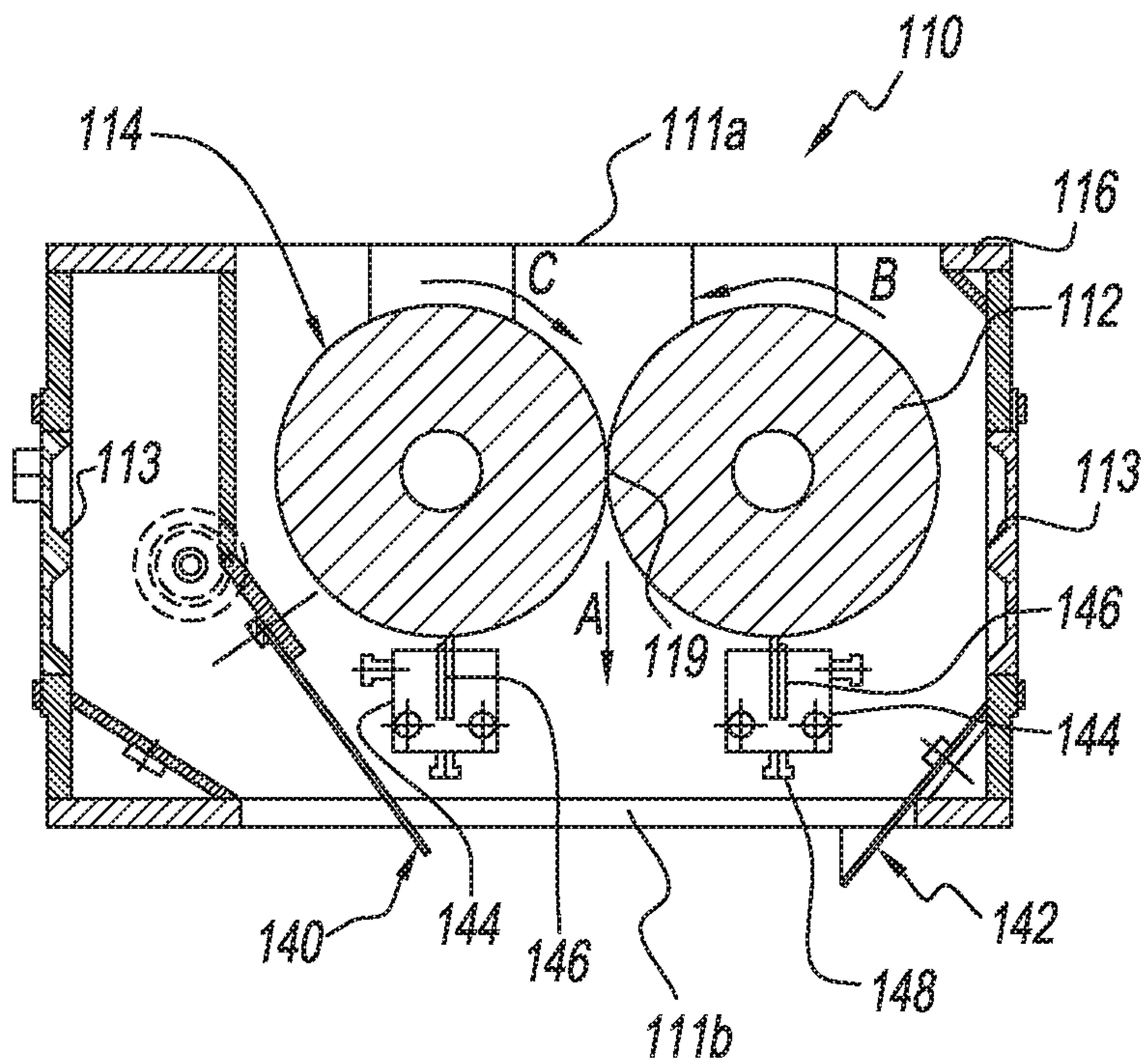

110
114
111a
116
C
B
112
113
113
146
A
119
144
140
144
146
111b
148
142

FIG. 4

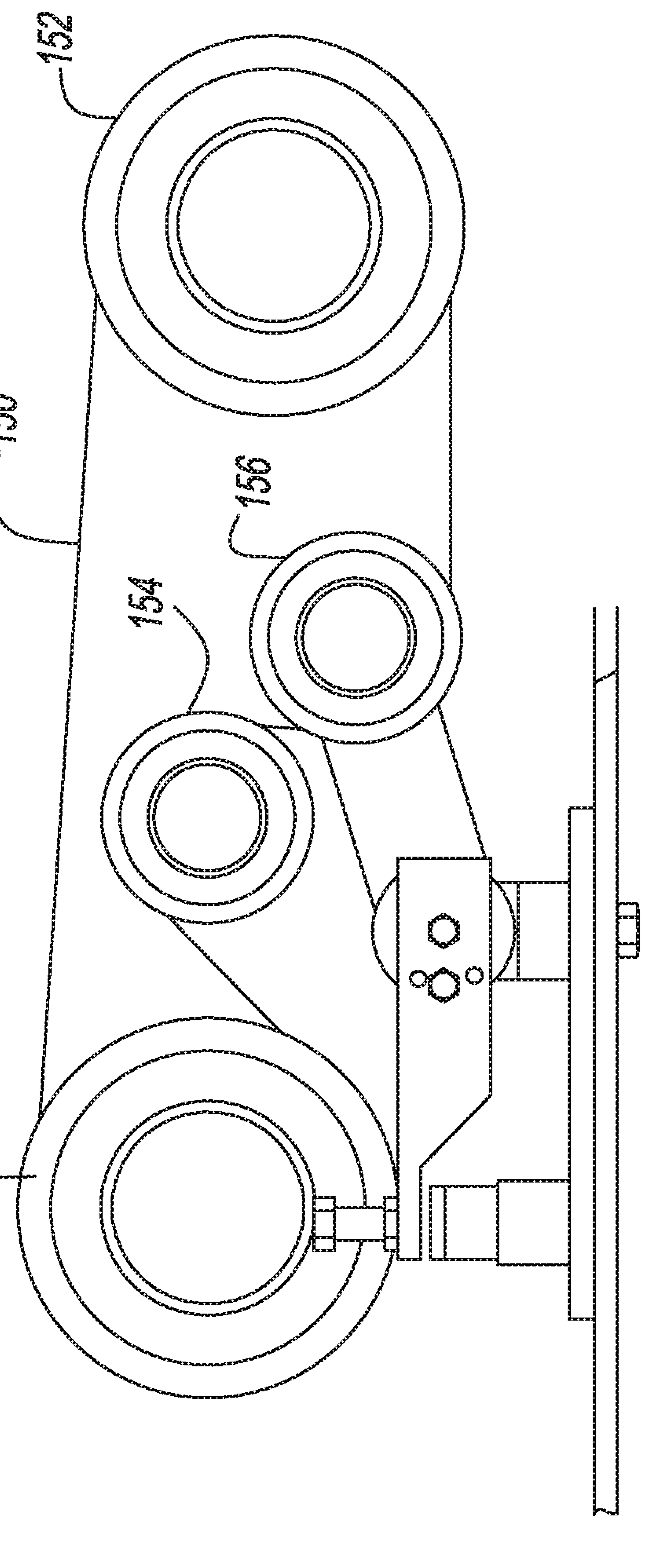
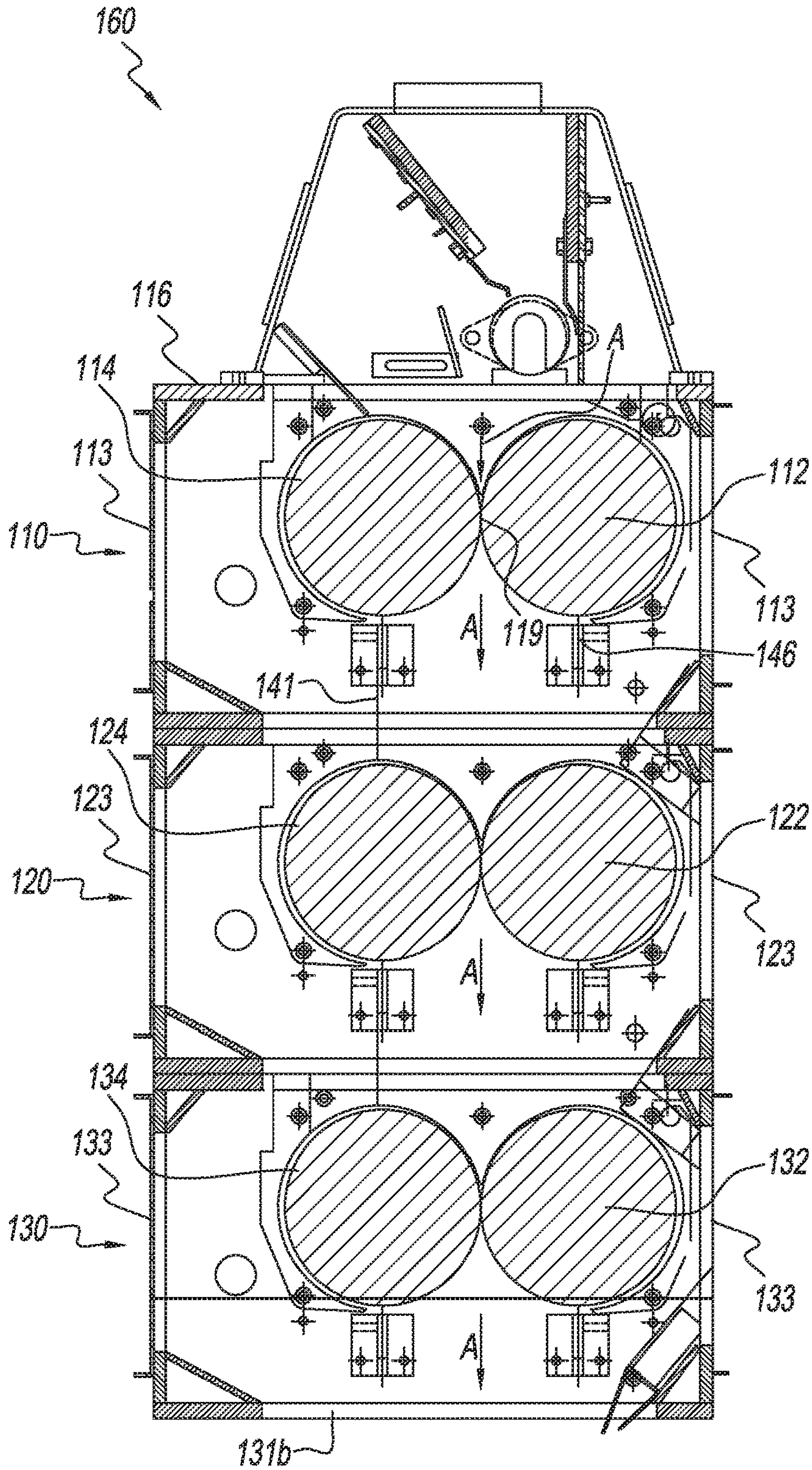


FIG. 5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116
114
113
110
A
112
113
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141
124
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122
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134
133
130
132
133
A
131b

FIG. 6

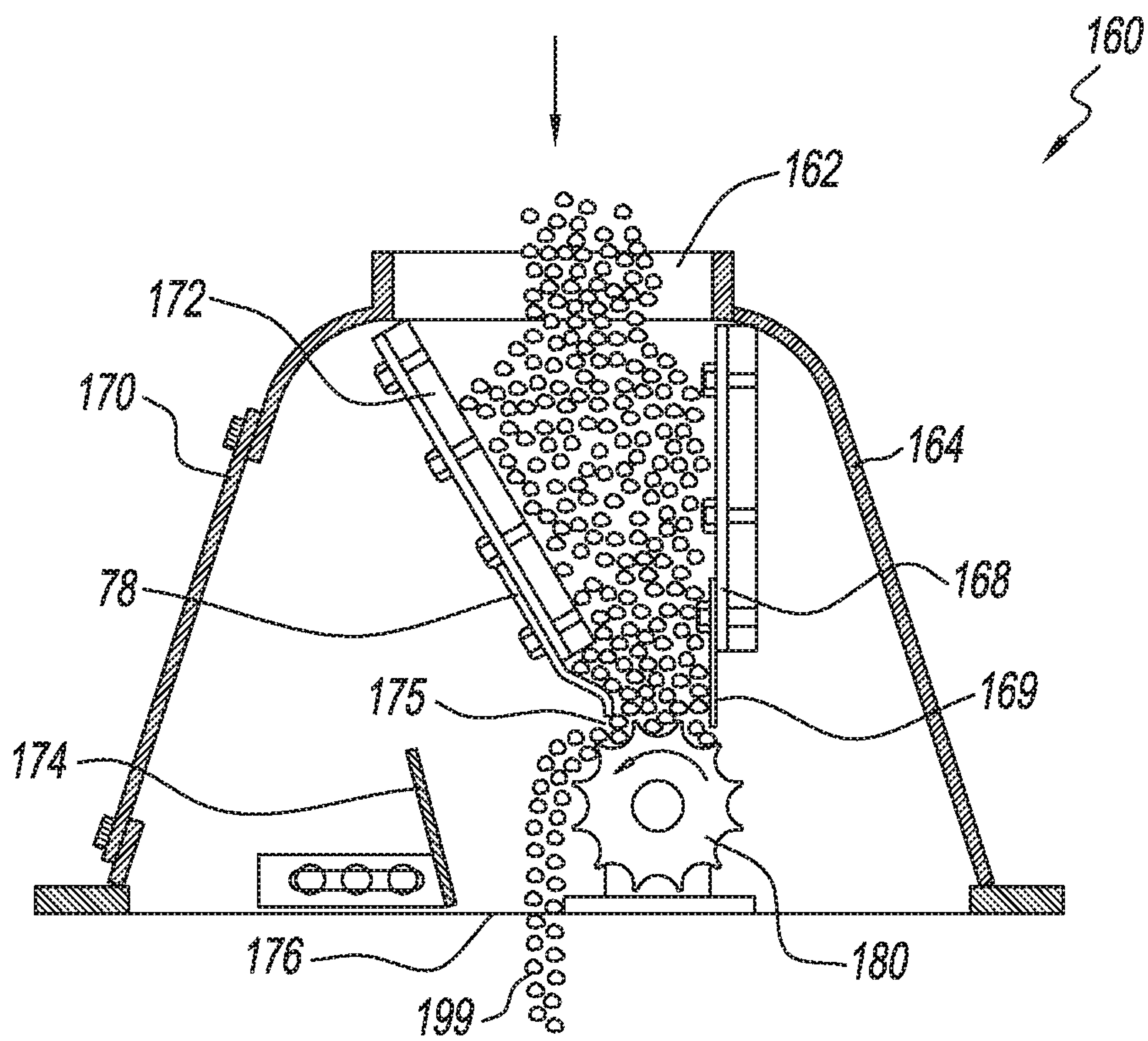


FIG. 7

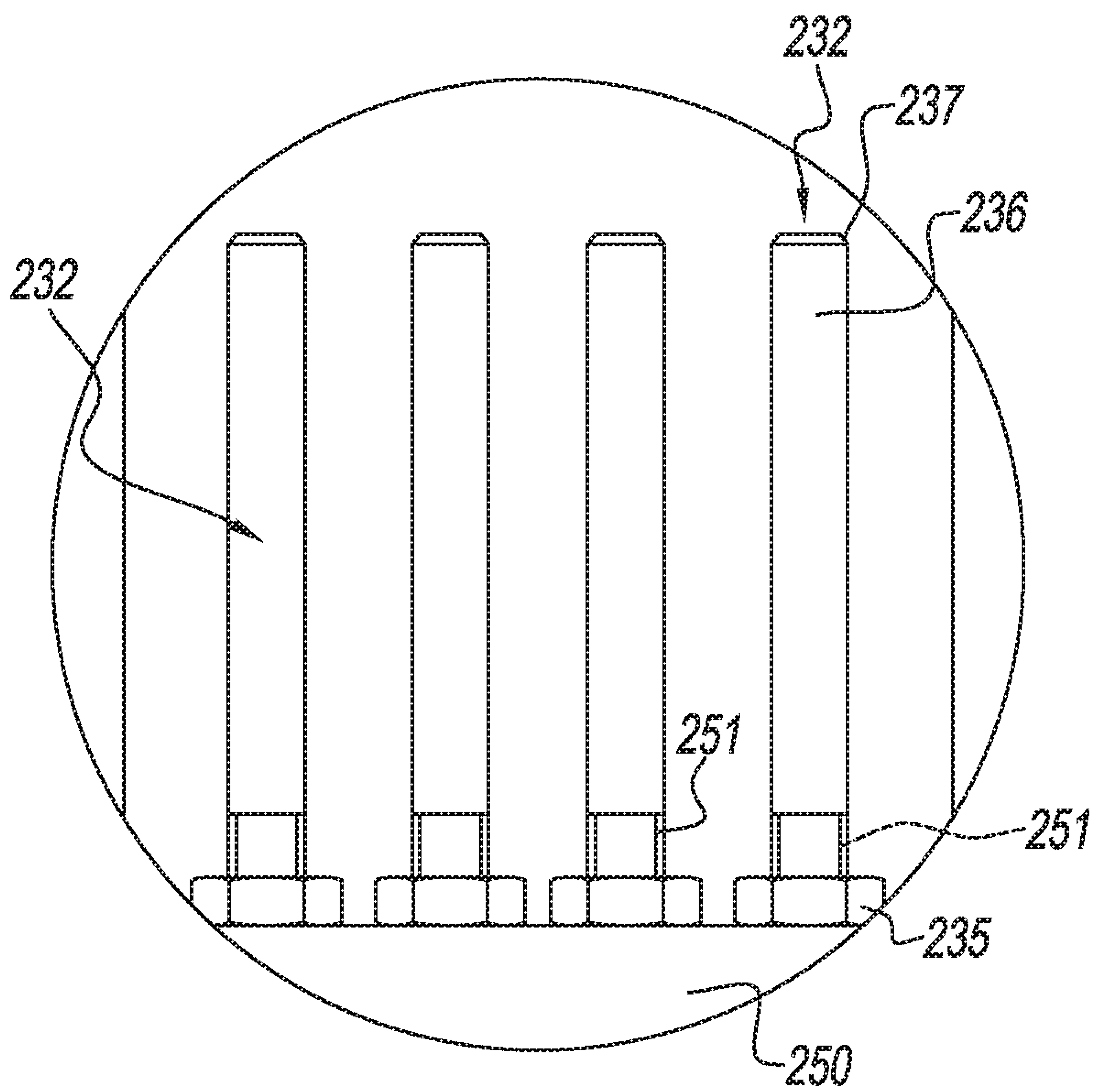
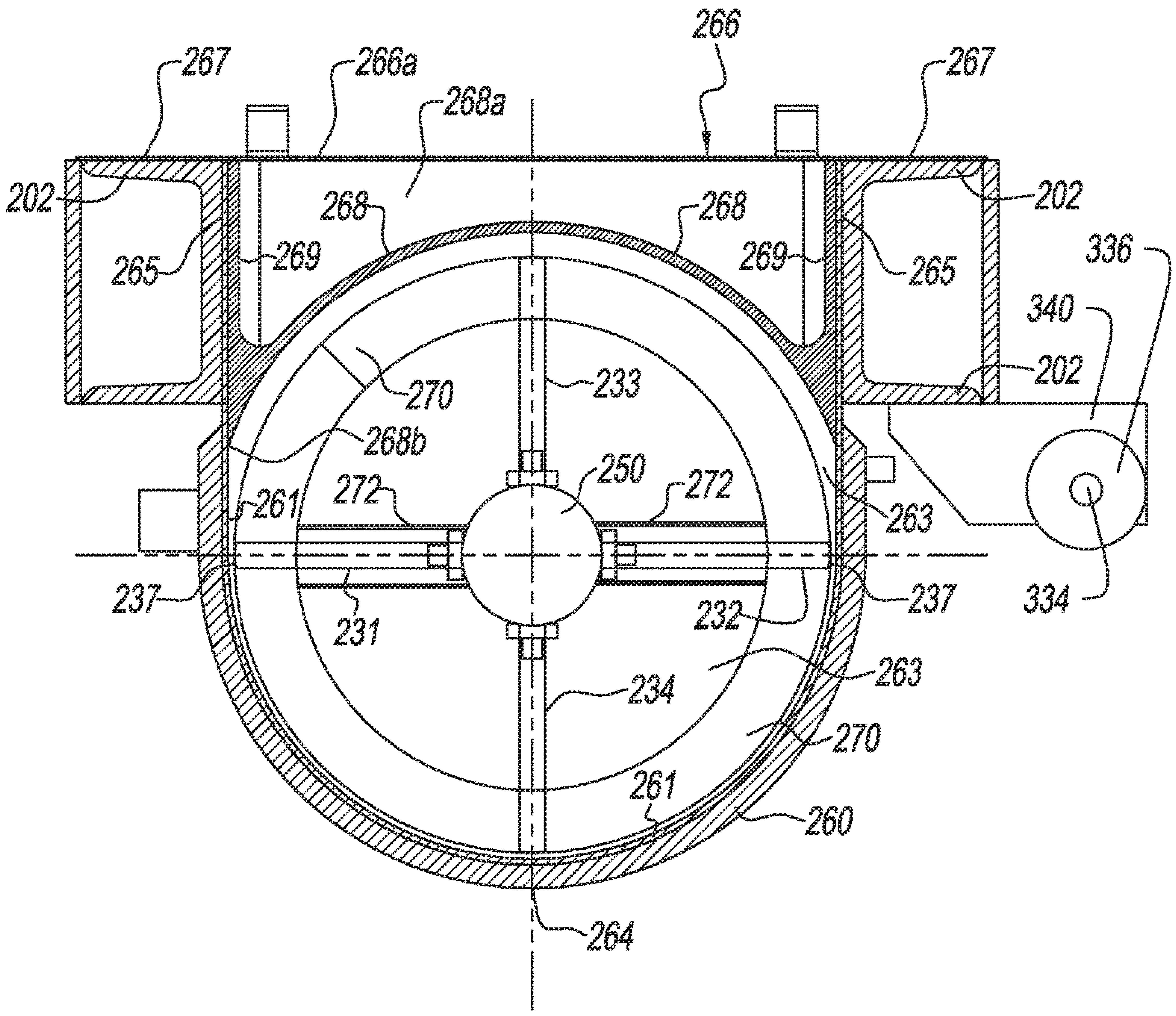


FIG. 8


266
267
266a
268a
267
202
202
268
268
265
269
269
265
336
340
270
233
202
268b
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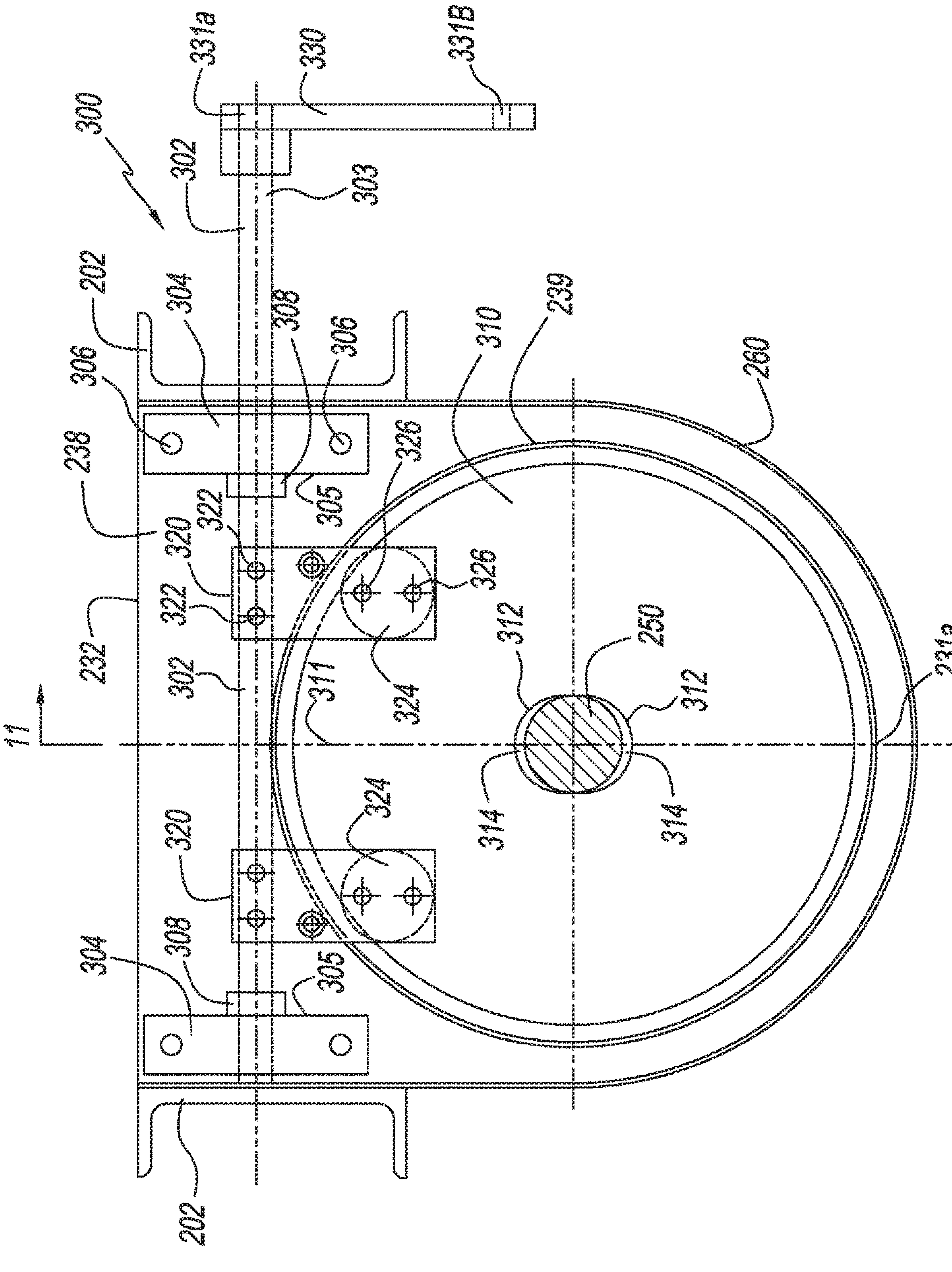
272
272
261
263
237
237
334
231
232
263
234
270
261
260
264

FIG. 9


300
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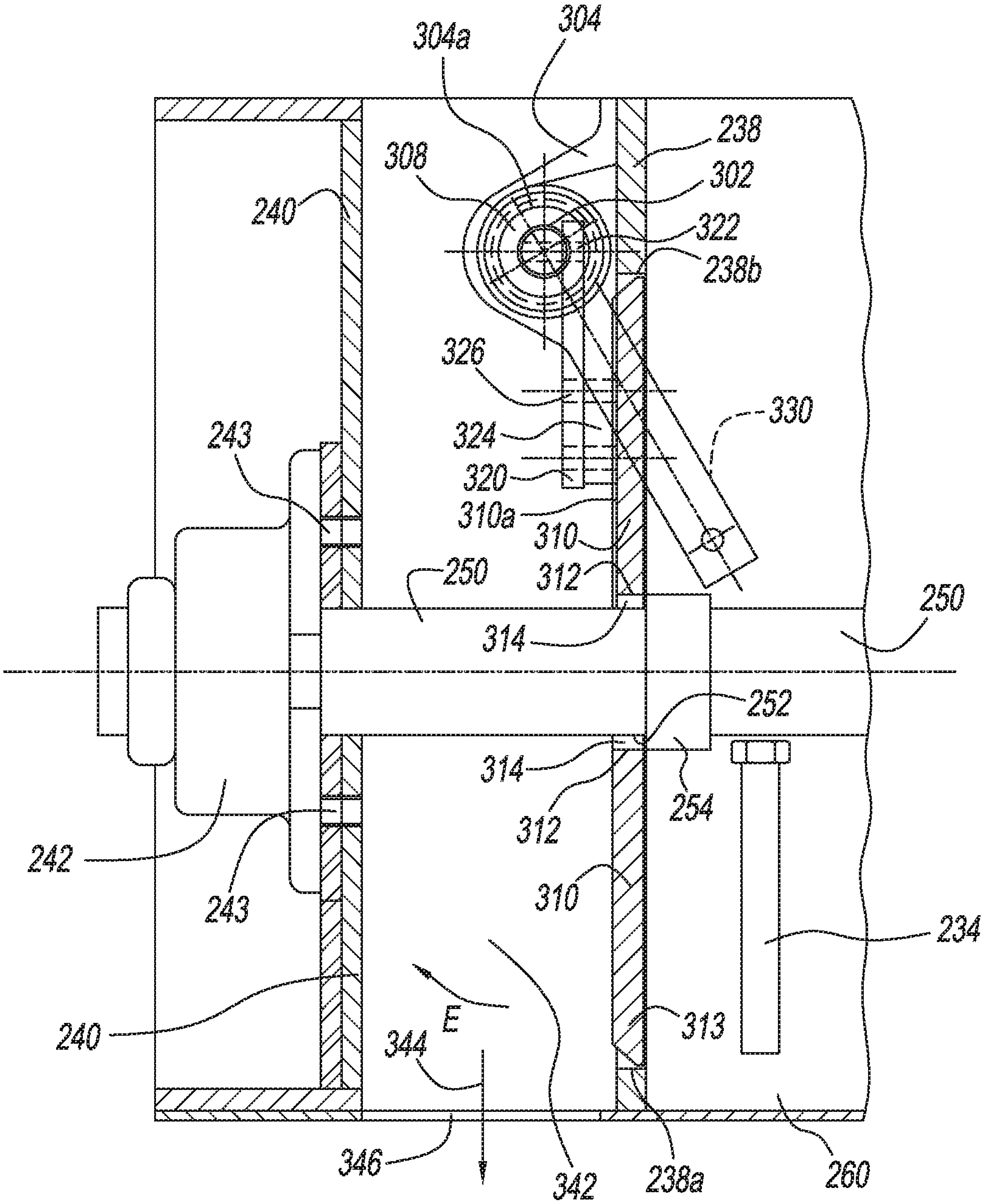
312
250
314
231a
11

FIG. 10


304a
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238b
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254
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310
234
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E
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346
342
238a
260

FIG. 11

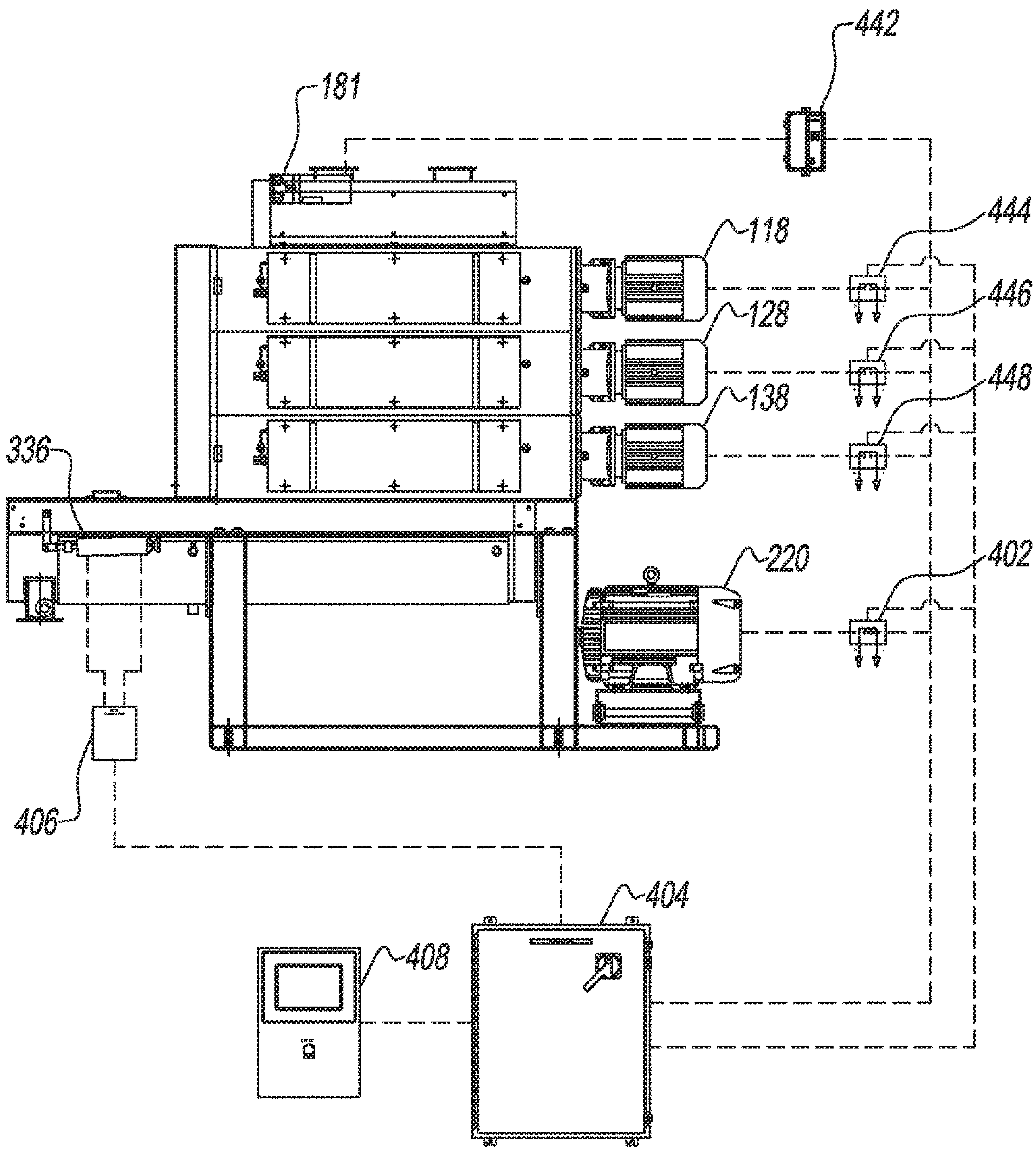
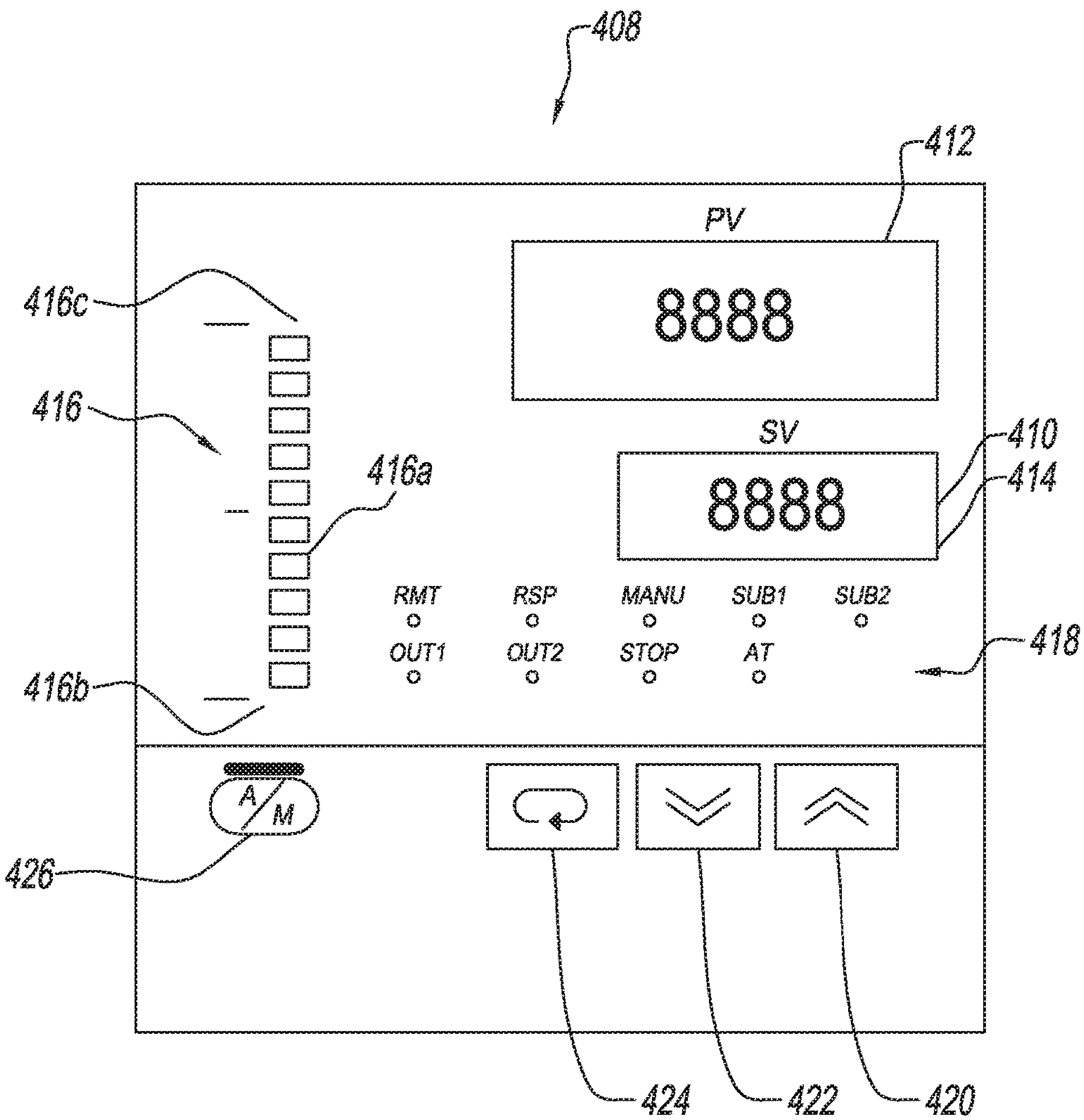


FIG. 12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PV
8888
SV
8888
410
414
416c
416
416a
416b
RMT
RSP
MANU
SUB1
SUB2
OUT1
OUT2
STOP
AT
418
A
M
426
424
422
420

FIG. 13

COFFEE DENSIFIER

This application is a divisional application of U.S. patent application Ser. No. 13/545,203, filed Jul. 10, 2012, which is herein incorporated by reference, and which claimed the benefit of U.S. Provisional Patent Application Ser. No. 61/545,757, filed on Oct. 11, 2011.

FIELD OF THE INVENTION

The invention relates to coffee densifiers.

BACKGROUND OF THE INVENTION

Industrial coffee grinders have been well known for a number of years. Coffee grinders frequently comprised one or more coffee grinding sections which may be stacked above a mixer. The mixer, which may comprise a screw conveyor, blends and conveys the coffee through a screw conveyor section to a discharge section.

Industrial coffee grinder mixer assemblies are frequently intended to be used to agitate and blend coffee to an increased bulk density level so that the ground coffee can be fit into a given amount of volume. This might be useful for products such as pods, capsules, and cans with smaller volume metric dimensions than standard. The present inventor recognized that it would be an advantage to provide a grinder mixer machine and method for producing high density coffee which could be adjusted to meet the specific requirements of downstream packaging.

As shown in U.S. Pat. No. 4,786,001, it is known to provide paddles within a coffee mixer, where the paddles extend from a rotatable mixer shaft. The paddles include a paddle arm fixed at one end to the mixing shaft and a paddle member extending perpendicularly from the paddle arm at an end of the paddle arm opposite the mixing shaft so that the paddles are a substantially T-shape.

The present inventor recognized that the paddles of the prior art mixers encounter a limit in the coffee density that can be imparted by the use of paddle mixing without creating excessive heat, which can over roast the coffee. The inventor recognized the paddles of the prior art mixers imparted unnecessary drag on the mixing motor during operation.

The present inventor recognized that, it would be desirable to provide a coffee densifier that produced a higher density coffee with less energy. The present inventor recognized that it would be desirable to provide a coffee densifier that is capable of producing coffee having a coffee density higher than that achievable by prior art paddle mixers.

Further the present inventor has recognized it would be desirable to provide an automatically control system for controlling the resulting coffee density being processed through a coffee densifier so as to maintain a consistent coffee density in the coffee exiting the densifier.

SUMMARY OF THE INVENTION

A coffee densifier is disclosed. In some embodiments, the coffee densifier comprises an elongated chamber, a densifier motor, a shaft, a plurality of densifier members, a discharge door actuator, a densifier motor load sensor, and a controller.

The elongated chamber is configured to receive a ground coffee. The chamber has an inlet and a discharge opening. The discharge opening comprises a discharge door. The inlet is for receiving the ground coffee in to the chamber.

The shaft is driven to rotate by the densifier motor and extends within the chamber.

The plurality of densifier members are fixed to the shaft and configured to polish a plurality of coffee particles of the ground coffee within the elongated chamber when the plurality of densifier members are rotated by the shaft through the ground coffee within the mixing chamber.

The discharge door actuator is operatively connected to the discharge door and configured to move the discharge door between an open position, a closed position, and at least one intermediate position.

The densifier motor load sensor is signal-connected to a controller and configured to report to the controller a densifier motor load on the densifier motor driving the plurality of densifier members polishing the ground coffee in the chamber.

The controller configured to signal the discharge door actuator to move the discharge door to increase or decrease a density of the ground coffee exiting the chamber through the discharge opening when the densifier motor load is outside a predefined densifier motor load operating range.

A coffee processor is also disclosed comprising a coffee grinder and the coffee densifier.

Numerous other advantages and features of the present invention will become readily apparent from the following detailed description of the invention and the embodiments thereof, from the claims and from the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side view of a coffee processor comprising a coffee densifier of the invention.

FIG. **2** is a top view of a mixer of the coffee processor of FIG. **1**.

FIG. **3** is an end view of the coffee processor of FIG. **1**.

FIG. **4** is a cross-section view of a portion of a coffee grinder of the coffee processor of FIG. **1**.

FIG. **5** is a grinder roller drive system of the coffee processor of FIG. **1**.

FIG. **6** is a cross-section end view the coffee grinder of the coffee processor of FIG. **1**.

FIG. **7** is a cross-section end view of an inlet section of the coffee processor of FIG. **1**.

FIG. **8** is an enlarged view of pins of the mixer.

FIG. **9** is a section view of the mixer taken along the line **9-9** of FIG. **1**.

FIG. **10** is a section view of the mixer taken along line **10-10** of FIG. **2**.

FIG. **11** is a section view of the mixer taken along line **11-11** of FIG. **10**.

FIG. **12** is a schematic view of the machine controller and connected components.

FIG. **13** is an exemplary screen of a display that is connected to the machine controller.

DETAILED DESCRIPTION

While this invention is susceptible of embodiment in many different forms, there are shown in the drawings, and will be described herein in detail, specific embodiments thereof with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the specific embodiments illustrated.

FIG. **1** shows coffee processor **100** having a coffee grinder **105** mounted above a mixer **200**. The grinder section is for grinding coffee, such as whole bean coffee, into coffee grounds. The mixer polishes the rough edges of the coffee particles that come out of the grinder to increase the coffee density.

The grinder has a top grinding section **110**, a middle grinding section **120**, and a bottom grinding section **130**. Each grinding section comprises a pair of grinding rollers **112**, **114**, **122**, **124**, **132**, **134**. The grinding rollers are journaled for rotation in a grinding roller support frame **116**. The support frame **116** in each section **110**, **120**, **130**, comprises a top entry opening **111***a* capable of allowing coffee product flow **199** to fall into the section and to come in contact with the rollers **112**, **114**. The support frame **116** also has bottom exit opening **111***b* to allow product flow to exit the section and proceed to through the top entry opening of the next adjacent section below or into the mixer **200**. The support frame also includes side access doors **113** on opposite longitudinal sides of the section.

Each pair of grinder rollers comprise a fast roller **112**, **122**, **132** and a slow roller **114**, **124**, **134**. The fast roller is close to an electric drive motor **118** and is rigidly mounted to the frame **116**. The slow roller **114** is mounted on a movable frame member **117** to allow the slow roller to be adjusted in position relative to the fast roller. There exists a roller gap **119** between the rollers. The adjustment of the position of the slow roller **114** relative to the fast roller **112** changes the width of the roller gap **119** between the rollers.

A slow roller deflector **140** and the fast roller deflector **142** are each mounted to the frame **116** to guide the coffee out of the section. The fast roller deflector and the slow roller deflector are arranged in a converging orientation as shown in FIG. **4**. Adjacent the bottom of the rollers are a scraper blocks **144** movably mounted to the frame **116** via an adjustment screw **148**. A scraper bar **146** is mounted to each scraper block **144**. The scraper bar is positionable in close proximity to the roller to prevent build-up of coffee material on the roller.

A second embodiment slow roller deflector **141** is shown in FIG. **6**. The second embodiment slow roller deflector is arranged substantially in parallel to the product flow direction, labeled as direction A. As is shown in FIG. **6**, each of the top grinding section **110**, the middle grinding section **120**, and the bottom grinding section **130** are arranged the same, except that the width of a roller gap **119** between the rollers in each section may be different than the gaps in the other sections and the bottom grinding section **130** does not have a slow roller deflector.

The fast roller **112** and the slow roller **114** are both driven by the electric drive motor **118** via a belt **150**. The drive motor is mounted to a motor frame **115** that is mounted the grinding roller support frame **116**.

A drive motor pulley **152** is connected to an output shaft of the drive motor **118**. The belt **150** extends from the drive motor pulley **152** around a tensioner pulley **156** to a fast roller pulley **154** to a slow roller pulley **158** and back around the drive motor pulley **152**. The fast roller pulley is connected to the fast roller. The slow roller pulley is connected to the slow roller. The belt drives the fast and slow rollers in opposite directions. As shown in FIG. **4**, the fast roller **112** rotates in direction B and the slow roller **114** rotates in direction C. The slow roller pulley **158** is larger than the fast roller pulley **154** and therefore the slow roller rotates slower than the fast roller pulley. In some embodiments, the rollers are corrugated. The corrugation size, shape, and spiral affect the final particle size of the coffee. In some embodiments, the rollers are smooth.

Above the top grinding section **110** is an infeed section **160**. The end of each section has a housing **164** with a top in feed inlet **162**. Coffee, such as roasted whole bean coffee, is loaded through the inlet **162** and is guided to the feed roller **180** by a first guide plate **168**, a second guide plate **172**, a first stop plate **169**, and a metering bar **178**. The metering bar **178** is connected to the second guide plate **172**. The metering bar **178** is adjustably positionable along the second guide plate **172** to vary the metering gap **175** between the end of the metering bar **178** and the feed roller **180**. The metering gap **175** allows only a predefined amount of product to exit the inlet section through an exit opening **176** at the bottom and into of the top grinding section **110**. An exit guide plate **174** ensures that coffee is directed into the correct location in the top grinding section **110**. The infeed section **160** has a side opening covered by a door **170** that is bolted to the housing **164**.

The rollers **112**, **114** of the top grinding section **110** may be considered crusher rollers. The rollers of the middle grinding section **120** may be considered finish rollers. The rollers of the bottom grinding section **130** may be considered fine rollers. In some embodiments, the rollers are water cooled by a water cooling system that circulates water through the rollers during the grinder's operation.

In some embodiments, the processor **100** has a machine controller **404**. The controller **404** controls aspects of machine operation including startup, shutdown, grind adjustment, roller gap, and coffee density control. The operator controls controller **404** using a user input device, such as a touch screen controller display panel **408** through a series of menus and user prompts provided on the user input device by the controller **404**.

The controller **404** is signal connected with each motor **118**, **128**, **138** to control the operation of each motor. Each motor has a grinder motor power transducer **444**, **446**, **448** that reports the real-time power load being used by the motor. The controller **404** is connected with a plurality of sensor that report to the controller **404** the gap distance between each of the pair of rollers. The controller **404** is signal connected to a sensor that reports the operation and rate of feed of the feed roller **180** via a feed motor speed controller **442**. The controller **404** is signal connected and controls a feeder motor **181** that drives the feed roller **180**, thereby controlling the rate at which coffee is infeed to the grinding rollers.

The controller **404** is signal connected to a grinder thermocouple and a mixer discharge thermocouple. The grinder thermocouple is located at the bottom grinding section **130** to report by signal to the controller **404** the temperature of the coffee exiting section **130**. The discharge temperature thermocouple is located on a discharge extension **348** to report by signal to the controller **404** the temperature of the coffee exiting the mixer. The controller **404** also controls the operation of the mixer as explained below.

Mixer. Product exiting the bottom exit opening **131***b* of the bottom grinding section **130** enters the mixer **200**. The mixer **200** has an elongated housing **260** which is generally U-shaped in transverse cross-section. The upper portions of the side walls **262** are generally vertically orientated and parallel. The lower portion of the sides merge with a bottom **264** in a generally semicircular configuration in transverse cross-section. The housing has a chamber **213** provided with vertical rear and front walls **211**, **238**. The housing has two sections, a receiving portion **210** and a densifier portion **230**. The housing provides a top opening **212** so that the coffee discharged from the grinder may drop into and be received in the receiving section. The housing has a top cover **266** covering the housing from the top opening **212** to a least the front wall **238**.

The mixer **200** has a mixer frame **202** that supported by four frame legs **204**. The legs are configured to support the mixer **200** and the grinder **105** on an external surface such as the ground or a floor. The legs maybe connected at an end opposite the housing **260** by a pair of floor rails **206**. Behind the rear most pair of frames legs **204**, as shown in FIG. **1**, is a mixer drive motor **220**. The mixer drive motor is mounted to a mixer support frame **208** that connects with the rear pair of frame legs **204** and the floor rails **206**.

The mixer comprises a mixer shaft **250** extending along a longitudinal centerline **252** of the mixer. The shaft **250** is supported at opposite ends of the shaft by front and rear bearing support members **240**, **244**. The bearing support members **240**, **244** are connected to the mixer frame **202**. The front bearing support member **240** receives a front mixer shaft bearing assembly **242** through which a front portion of the mixing shaft **250** is journaled for rotation. The rear bearing support member **244** receives and supports a rear mixer shaft bearing assembly **246** through which a rear portion of the mixing shaft **250** is journaled for rotation.

The front bearing support member **240** is located adjacent a front wall **238** of the densifier **230**. The rear bearing support member **244** is located adjacent a rear wall **211** of the receiving portion **210**.

The mixer motor **220** drives the mixing shaft **250** through a belt drive system. The belt drive system comprises a drive pulley **224**, a driven pulley **226**, and the drive belt **228**. The drive pulley **224** is connected to the output shaft **222** of the mixer motor **220**. The driven pulley **226** is connected to the mixing shaft **250**. The drive belt is connected around the driven pulley **226** and the drive pulley **224** to transfer the rotary motion of the motor to the driven pulley and thereby to the mixing shaft **250**. The mixer motor **220** is positioned below the housing **260** and supported on a support platform **209** connected to the mixer support frame **208**.

A spiral auger **270** is connected to the mixing shaft by protruding tabs **272**. The tabs are attached to the mixing shaft **250** by fasteners. As shown in FIG. **9**, the tabs **272** space the auger **270** apart from the mixing shaft **250**. The protruding tabs **272** extend from a portion of the spiral auger **270**. The spiral auger turns in sync with the mixing shaft **250**. The tabs **272** are at least located on opposite sides of the auger **270** about the mixing shaft **250**. Therefore when the mixing shaft **250** is in the position shown in FIG. **2** the tabs **272** attached at a first tab connection on a surface of the mixing shaft and at an opposite second tab location **273**. The spiral auger **270**, as it rotates, moves coffee from the receiving portion **210** towards the densifier portion **230**. In some embodiments, the auger **270** extends at least 50 percent of the length of the chamber **213**. In some embodiments, the auger **270** extends between 40 and 70 percent of the length of the chamber **213** with the remaining length comprising the densifier portion.

Pins **231**, **232**, **233**, **234** are connected to the mixing shaft **250** in the densifier portion **230**. Pins **231**, **232**, **233**, **234** are all identical. As is shown in FIG. **2**, the pins **232**, **234** begin along the mixing shaft adjacent the end of the spiral auger **270**. As is shown in FIGS. **2** and **9**, the pins are arranged in four rows that provide a cross formation extending radially from the mixing shaft **250**. Each radially adjacent pin is positioned ninety degrees from the other radially adjacent pins in each radial direction. Pins **231** are opposite pins **233** and are aligned through a vertical cross-section. Pins **232** are opposite pins **234** and are aligned through a vertical cross-section. Radially adjacent pins, such as pins **231** and **233**, are offset in the longitudinal direction of the shaft **250** as shown in FIG. **2**. Therefore pins **231**, **232** are not aligned with pins **234**, **233**, through a vertical cross-section. The radially adjacent offset nature of the pins allows better contact with coffee during the normalization and densifying process in the densifier.

In some embodiments, the each longitudinally adjacent pin along the length of the mixing shaft is paced 0.875 inches from the next longitudinally adjacent pin. In some embodiments, a longitudinally centerline of the each longitudinally adjacent pin along the length of the mixing shaft is paced 1.5 inches from a longitudinally centerline of the next longitudinally adjacent pin.

Each pin **231**, **232**, **233**, **234** has a shaft **236** extending from a nut head **235**. Opposite the nut head **235** is a tapered distal end **237**. In some embodiments, the shaft **250** comprises a plurality of thread pins studs **251** extending from the distal surface of the shaft **250**. Each pin has a hollow threaded opening opposite the tapered distal end **237**. The hollow threaded opening mates with the threaded pin stud **251** and the nut head **235** enables the user to tighten the pins down to the surface of the mixing shaft **250**. In some embodiments, the mixing shaft **250** has a plurality hollow threaded holes that receive a threaded stud extending from the nut head **235** of each pin. In either embodiment, the removal ability of the pins through the threaded attachment with the mixing shaft **250** allows pins to be individually replaced if they are worn or damaged.

In some embodiments, the pins **231**, **232**, **233**, **234** are hardened through a traditional process of hardening metal, which may include heading the pins to a predefined temperature and then cooling the pins to increase pin strength. During operation the pins are rotated by the shaft **250** to agitate a bed of coffee within densifier portion **230**. This agitation by the pins increases the bulk density of the coffee by polishing the rough edges of the coffee particles that come out of the grinder. The more time the coffee particles spend in the densifier portion **230** the more polished the coffee particles become. As the rough edges are polished the particles can fit closer together relative to the others and therefore the resulting coffee density is increased.

Referring to FIG. **9**, the tapered distal end **237** of the pins **231**, **232**, **234** are located in close proximity to the inside surface **261** of the housing **260**. This ensures that all coffee in the densifier portion **230** is agitated during the rotation of the pins and moved and no substantial amount coffee is allowed to sit at the bottom of the housing **260** unmoved. The housing **260** is provided with the cover **266**. The cover has support wings **267** which rest on top of the frame **202** on opposite sides of the housing **260** and support the cover. Between the wings **267**, and an opposite the top surface **266*a*** is a semicircular lid bottom **268**. The lid bottom **268** is connected to a top surface **266*a*** of the cover by lid side walls **269**. An open space **268*a*** exists between the top surface **266*a*** and the lid bottom **268**. The lid sidewalls **269** contact with or are in close proximity to the upper side walls **265** of the housing **260**. When the cover is placed over the housing **260** as shown in FIG. **9**, the lid bottom to **268** and the inside surface **261** of the housing below a lower most edge **268*b*** of the lid bottom form a chamber **263** within which the pins operate the densification process on the coffee. More space is provided between the lid bottom **268** and the pins then is provided between the inside surface **261** of the housing **260** and the pins. The cover **266** and the lid bottom **268** insurer that coffee is kept in close proximity to the pins during operation and that coffee is not thrown into dead space above the pins that might otherwise exist without the lid bottom **268**.

The mixing shaft of mixer **200** having pins **231**, **232**, **233**, **234** can be operated at twice the rotation speed of certain prior art mixers using paddles. The mixer **200** having pins realizes a 30% to 35% reduction the energy needed to turn the mixer shaft with pins, as compared to prior art mixers using paddles, to achieve the same density in the coffee output from the mixer as the prior art paddle mixers. This reduction in energy is achieved even with an increased rotation speed of the pins as compared to prior art paddle mixers. The mixer **200** having pins is capable of achieving a higher coffee density without negatively impacting the coffee, such as by imparting too much heat to the coffee, than can be achieved with prior art mixers using paddles. This is due, at least in part, to the reduced drag against the coffee created by the pins as compared to the prior art paddles. Further, in some embodiments, the mixing shaft **250** has more pins than paddles found in prior art mixers.

Automatic Density Control System. The mixer **200** has an automatic density control system (ADCS) **300**. The ADCS **300** controls a discharge door **310** through a linear actuator, such as pneumatic cylinder **336**. The discharge door **310** is located in a discharge door opening **239** of the front wall **238**. The pneumatic cylinder is connected to a pressurized are supply system.

The discharge door arrangement is shown in FIGS. **1**, **2**, **10**, and **11**. The discharge door **310** occupies a discharge door opening **239** in the front wall when the discharge door is in a full closed position. The discharge door is movable between the full closed position and a full open position and any position between the full closed and full open positions. The discharge door is fixed to a pivot rod **302** by a pair of door brackets **320**. At a top end of the door bracket, a pair of fasteners **322** fix the door bracket to the pivot rod **302**. At a bottom end of the door bracket opposite the top end, a door bracket spacer **324** is positioned between the back surface of the door bracket **320** and a surface of the discharge door **310**. A pair of fasteners (not shown) are fixed through a pair of the mounting holes **326** that extend through the door bracket, through the door bracket spacer, and into the door. The door bracket spacer **324** may be a circular shape such as shown in FIG. **11** or may be any other shape. The door brackets **320** are spaced apart about a vertical mid-line **311** of the door **310** as shown in FIG. **11**.

The rod **302** is pivotally connected to the front wall **238** by a pair of spaced apart pivot rod supports **304**. The pivot rod supports **304** are attached to the front wall **238** by a pair of fasteners **306**. Each pivot rod support **304** has an opening **304*a*** through which the pivot rod extends and pivots therein. A pair of pivot rod collars **308** may be fixed to the pivot rod adjacent inside walls **305** of each pivot rod support **304**. The collars **308** prevent the transverse movement of the pivot rod and thereby maintain the transverse position of the discharge door **310** relative to the discharge door opening **239**. In some embodiments, a bearing assembly is contained within the pivot rod support to facilitate the movement of the pivot rod.

The discharge door **310** has a center opening **312**. The center opening **312** comprises an upper semicircular portion and a lower semicircular portion. Each semicircular portion allows gaps **314** between the discharge door **310** and the shaft **250** in the upper and lower areas of the center opening **312** when the door is in the closed position. The gaps **314** allows a bottom end **313** of the discharge door **310** can move away from the front wall **238** in the direction E shown in FIG. **11** to create an opening between the discharge store **310** and the front wall **238**. In some embodiments, the gaps **314** are sufficient to allow the discharge door **310** to move in the direction E to the point where the bottom of discharge door makes contact with or is adjacent to the bearing support plate **240**. As the door pivots open about the pivot rod **302**, the gap between the discharge door **310** and a bottom edge **238*a*** of a front wall **238** is greater than the distance between the discharge door **310** and a top edge **238*b*** of a front wall **238**. A mixing shaft collar **254** is located on the densifier side of the discharge door adjacent the pins as shown in FIG. **11**. The mixing shaft collar **254** prevents coffee from escaping from the densifier portion **230** through the gaps **314** when the door is in the full closed position.

The pivot rod **302** extends outside of a frame member of the frame **202** to connect to pivot arm **330** as shown in FIG. **10**. A top end **331*a*** of the pivot arm **330** is fixed to the pivot rod **302**. A bottom end **331*b*** receives a pin connecting a connector **332** attached to a piston rod **334** of the pneumatic cylinder **336**. A rear end of the pneumatic cylinder **336** is pivotally attached to a linear actuator support **340** that is fixed to the frame **202** as shown in FIGS. **1** and **9**.

In some embodiments, a knurled adjustment collar **333** is located along the cylinder rod **334**. The location of the adjustment collar **333** can be moved along the rod to manually set a cylinder rod minimum beyond which further retraction into the cylinder is not possible. Turning the collar **333** changes the preload on an internal pilot (not shown) inside the cylinder. The adjustment collar is held in place with two lock screws that must be loosened before turning the collar.

When the discharge door **310** is in any open position, as positioned by the pneumatic cylinder, coffee will be allowed to be discharged passed the discharge door **310**, down through a discharge passage **342**, along a discharge path **344**, passing out a discharge opening **346** and out though a discharge extension **348** to an external receptacle (not shown). The discharge extension **348** has a flange **349**. The flange **349** has at least to bolt holes (not shown) for securing the attachment of an external pipe, hose, or other connector.

The ADCS **300** comprises a mixer motor power transducer **402**, the controller **404**, and a cylinder controller **406**, the cylinder **336**, and the discharge door **310**. The power transducer **402** measures the power consumed by the mixer motor **220** and sends a load signal in the range of 4 milliamps (mA) to 20 mA to the controller **404** depending on the power consumed by the mixer motor **220**. The pneumatic cylinder is positioned by the properly distributed compressed air provided by the cylinder controller **406**, using the supplied air pressure, and positions the pivot arm **330** and thereby a discharge door **310** in any position within of the stroke pneumatic cylinder. In some embodiments, the cylinder controller is a current-to-pneumatic controller. In some embodiments, the cylinder controller is a current-to-position controller.

The controller **404** has, or is in signal communication with, a controller display panel **408**. In some embodiments, the controller display panel **408** is a touch screen having user-interactive portions where the display panel is capable of receiving user input by a user touching one or more touch areas of the display panel. In some embodiments, the controller display has a screen displaying a power value display portion **412**, a mixer motor load setpoint value display portion **414**, a mixer speed setpoint display portion **410**, a status display portion **418**, a door position display portion **416**, manual/auto selector button **426**, an up value button **420**, a down value button **422**, and a reset button **424**. The power value display portion **412** is configured to display the current power being consumed as reported to the controller the power transducer **402**. The mixer motor load setpoint value displayed portion **414** is configured to display a mixer motor load setpoint. The mixer speed setpoint display portion **410** is configured to display the mixer shaft rotation speed setpoint. In some embodiments, when the display panel **408** is a touch screen, buttons **420**, **422**, **424**, **426** are touch areas capable of receiving user input. In some embodiments, each of the display portions **410**, **412**, **414**, **416**, **418** comprise a digital display and the buttons **420**, **422**, **424**, **426** are physical buttons. In some embodiments, less than all of the display portions shown in FIG. **13** may be provided on the display panel **408**. In some embodiments, the mixer speed setpoint display portion **410** is provided on a separate display (not shown) connected to the controller. It will be appreciated that the display portions shown in FIG. **13** can be provided on the same display panel or on one or more separate displays and/or remote displays.

In some embodiments, instead of providing one machine controller **404** that controls the operation of the entire grinder and mixer combination, a separate grinder controller and mixer controller are provided. In such an embodiment, the controllers are signal connected to each other so that appropriate data can be passed between each.

The door position display portion **416** is configured to display the degree to which the discharge door **310** is open. In one embodiment, the door position display portion **416** comprises a number of indicators **416***a* between a bottom **416***b* and a top **416***c*. The position of the discharge door **310** is shown by the proportion of indicators illuminated between the bottom and the top of the discharge display portion **416**. The more indicators **416***a* that are illuminated correspond to a greater degree of opening of the discharge door **310**. In some embodiments, the degree of discharge door opening is displayed in as a numeric value. In some embodiments, the degree of discharge door opening is represented as a graphical picture showing the degree of door opening.

The status display portion **418**, provides a number of mode indicators (not shown) that indicate the status of various components of the automatic density control system. For example, a manual/automatic mode status indicator may be provided in the status display portion **418** to indicate whether the automatic density control system is in a manual mode or in automatic mode. The manual/auto selector button **426** enables a user to select between the manual mode or the automatic mode.

The up value button **420** and the down value button **422** are configured to enable a user to adjust any user adjustable values or settings, including the mixer load setpoint when the automatic density control system is in the automatic mode and the discharge door **310** position when the automatic density control system is in the manual mode. The reset button **424** enables a user to reset user definable settings, such as the mixer motor load setpoint value to a predefined default and also to reset the door position value to a predefined default.

In operation, the machine controller **404** implements a mixer load control function that is configured to compare a mixer motor load signal received from the power transducer **402** to the mixer motor load setpoint, which may be predefined or may be set by the operator at the controller display panel **408** by using the up value button **420** or the down value button **422**, or via a physical or on-screen keyboard (not shown). The controller **404** receives real-time data on the power being consumed by the mixer motor **220** through the power transducer **402**, which is displayed on the power value display portion **412** of the controller display panel **408** by the controller **404**.

The controller **404** has a mixer startup function that functions during initial grinding. The controller **404** positions the discharge door in the full closed position until coffee in the mixer has reached a predefined level defined by the motor load setpoint that was predefined or defined by the operator at the controller display panel **408**. If the motor speed remains constant, larger amounts of coffee in the mixer will result in a higher motor load and smaller amounts of coffee in the mixer will result in a lower motor load. Therefore there is a correlation between the amount of coffee in the mixer and the mixer motor load for a given mixer speed.

If the discharge door is in the completely closed position and coffee is being added to the mixer by the grinder the amount of coffee in the mixer will increase. The increase in the amount of coffee in the mixer will increase the load on the mixer motor **220** because additional energy will be required to rotate spiral auger **270** and the pins **232**, **234** against the increased amount of coffee in the mixer. Once the load on the mixer motor **220** reaches the motor load set point, the controller **404** will signal the pneumatic cylinder **336**, through the cylinder controller **406**, to extend the cylinder rod **334** and open the discharge door **310** a predefined distance. As coffee is allowed to escape through the discharge, the motor load will increase at a decreasing rate, will stabilize, or will be reduced depending on the rate of inflow of coffee from the grinder and the degree to which the discharge door is open. Preferably, the door will be opened a sufficient distance so that the motor load stabilizes at the predefined set point.

During operation the a mixer load control function of the controller **404** continuously, or at regular intervals, monitors the load on the mixer motor **220** through the signal received from the power transducer **402**. When coffee is being constantly fed into the mixer from the grinder, a flow of coffee is passing through the mixer from the receiving portion **210** through the densifier portion **230** and out the discharge extension **348**. The controller **404** will continuously, or at regular interval, signal the cylinder controller **406** to signal the cylinder rod to extend to open the discharge door a predefined amount or to retract the discharge door a predefined amount to maintain a consistent motor load by adjusting the amount of coffee resident in the mixer at a given time.

If the mixer motor load signal is above the mixer motor load setpoint, the controller **404** will send a signal to the cylinder controller **406**, which will signal to the pneumatic cylinder to extend the cylinder rod a predetermined distance to open the discharge door in the direction E in FIG. **11** a predetermined amount. Further opening the discharge door will result coffee in the mixer being discharged at a faster rate, so that less coffee is retained in the mixer and the coffee spends a less amount of time in the mixer. As less coffee is retained in the mixer, the coffee will provide less of a load the mixer motor **220** because less energy is required to rotate a smaller amount of coffee within the mixer.

If the mixer motor load signal is below the mixer motor load setpoint, the machine controller **404** will send a signal to the cylinder controller **406** which will signal to the pneumatic cylinder to retract the cylinder rod a predetermined distance to retract the discharge door **310** in the direction opposite direction E in FIG. **11** a predetermined amount. Retracting the discharge door will result in coffee in the mixer being discharged at a slower rate, so that more coffee is retained in the mixer and the coffee spends a longer amount of time in the mixer. As more coffee is retained in the mixer, the coffee will increase the load the mixer motor **220** because additional energy is required to rotate spiral auger **270** and the pins **232**, **234** against the increased amount of coffee in the mixer.

When coffee is resident within the densifier portion **230**, the coffee is subjected to the impact of the pins **232**, **234** and a corresponding agitation with other coffee materials within the densifier portion **230**. One way of increasing the density in the coffee discharged from the mixer, is to increase the motor load set point. A higher mixer motor load setpoint will reduce the coffee chaff and increase coffee density. Coffee chaff is created during the grinding operation and the densifier operates to break up the chaff as well as to densify the coffee. An increased motor load set point corresponds to coffee being retained in the densifier portion **230** for a longer period of time. A higher mixer motor load setpoint will also raise the coffee temperature. Therefore, it is preferred to use to lowest motor load set point that will achieve the desired coffee density.

A higher mixer shaft rotation speed setpoint will result in higher coffee density. An increase in the mixer shaft rotation speed will increase the speed at which coffee in the densifier achieves a given density. Therefore operating the mixer shaft at an increased speed on the same amount of coffee in the densifier will increase the load on the mixer motor, thereby causing the discharge door to be opened to a larger degree to maintain the load at the motor load set point. Operating the mixer at a faster speed on a given volume of coffee in the densifier will increase the throughput of coffee out of the mixer. Correspondingly, throughput can remain constant if the volume of coffee is reduced proportionally when the mixer shaft speed is increased.

Retracting the discharge door while the mixer is operating and being fed with a relatively constant flow of coffee grounds from the grinder will (1) decrease the rate at which coffee exits the mixer, (2) increase the mixer motor load, (3) increase the density of the coffee exiting the mixer, (4) increase the resident time which the coffee grounds are retained in the mixer before exiting, and (5) will decrease the amount of coffee chaff in the exiting coffee. Opening the discharge door while the mixer is operating and being fed with a relatively constant flow of coffee grounds from the grinder will (1) increase the rate at which coffee exits the mixer, (2) decrease the mixer motor load, (3) decrease the density of the coffee exiting the mixer, (4) decrease the resident time which the coffee grounds are retained in the mixer before exiting, and (5) increase the amount of coffee chaff in the exiting coffee.

In some embodiments, the mixer motor load setpoint is a mixer motor load operating range. The controller **404** is configured to move the discharge door when the mixer motor load is outside of the mixer motor load operating range.

In one embodiment the controller **404** utilizes proportional-integral-derivative logic to calculate the output signal that should be sent to the cylinder controller **406**. In some embodiments the cylinder controller **406** converts a signal in the range of 4 mA to 20 mA from the machine controller **404** to the proper cylinder position. In some embodiments, the controller **404** is programmable by the operator to adjust the maximum full open and full close positions of the discharge door **310** by setting a fully extended cylinder rod position and a fully retracted cylinder rod position.

In some embodiments, the controller **404** comprises a cleanout function. The cleanout function opens the discharge door **310** to the full open position after a predefined no-grind time period has elapsed in which the control receives a signal that the grinder motor load from one of the motors **118**, **128**, or **138** is below a predefined in-operation load setpoint. When such motor load is below the in-operation grinding load setpoint, no coffee is being ground as the grinding of coffee between the rollers generates the in-operation grinding load on the corresponding motor **118**, **128**, or **138**. After the motor load has dropped below the in-operation grinding load set point for a predefined elapsed no-grind time period, the controller **404** signals to open the discharge door **310** for a predefined cleanout time period to allow the coffee material in the mixer to be discharged. The cleanout function is beneficial because if no additional coffee is being feed into the machine, then the motor load in the mixer will decrease. If the motor load in the mixer decreases, the controller **404** will signal the discharge to close proportionally the discharge door to maintain the mixer motor load at the predefined set point. Eventually the discharge door will close completely and the mixer will continue to agitate and rotate the coffee grounds. Excessive densification by the mixer may result in resulting coffee grounds that do not meet the operator's output requirements for coffee density.

In some embodiments, the controller **404** allows a user to set the cleanout door position that is used during the cleanout function so that the user may control the rate of coffee grounds discharged during the cleanout operation. The controller **404** may display a cleanout progress indicator on the display panel **408**, which shows the progress in completely discharging the contents of the mixer.

In some embodiments, the mixer is water cooled. The mixer comprises a stainless steel water cooled jacket within the walls **262** and/or bottom **264** of the housing. The water cooling is achieved by circulating water through the water jacket. Water is circulated by one or more pumps controlled by the machine controller **404**. The temperature of the coffee exiting the mixer is measured by the discharge temperature thermocouple. Circulating water through the water jacket dissipates heat from the mixer and the coffee therein. Water flow is started, stopped, increased or decreased to change the temperature of the mixer and the coffee therein.

The controller **404** may be a an application-specific integrated circuit (ASIC) having one or more processors and memory blocks including ROM, RAM, EEPROM, Flash, or the like; a programmed general purpose computer having a microprocessor, microcontroller, or other processor, a memory, and an input/output device; a programmable integrated electronic circuit; a programmable logic controller or device; or the like. Any device or combination of devices on which a finite state machine capable of implementing the procedures described herein can be used as the controller **404**.

From the foregoing, it will be observed that numerous variations and modifications may be effected without departing from the spirit and scope of the invention. It is to be understood that no limitation with respect to the specific apparatus illustrated herein is intended or should be inferred.

The invention claimed is:

1. A coffee densifier, comprising:

an elongated chamber configured to receive a ground coffee, the chamber having an inlet and a discharge opening, the discharge opening comprising a discharge door, the inlet for receiving the ground coffee;

a densifier motor;

a shaft that is driven to rotate by the densifier motor and extending within the chamber;

a plurality of densifier members fixed to the shaft and configured to polish a plurality of coffee particles of the ground coffee within the elongated chamber when the plurality of densifier members are rotated by the shaft through the ground coffee within the chamber;

a discharge door actuator operatively connected to the discharge door and configured to move the discharge door between an open position, and a closed position, and at least one intermediate position;

a densifier motor load sensor that is signal-connected to a controller and configured to report to the controller a densifier motor load on the densifier motor driving the plurality of densifier members polishing the ground coffee in the chamber;

the controller configured to signal the discharge door actuator to move the discharge door to increase or decrease a density of the ground coffee exiting the chamber through the discharge opening when the controller detects the densifier motor load, as reported by the densifier motor load sensor, is outside a predefined densifier motor load operating range.

2. The coffee densifier of claim **1**, wherein the densifier motor load operating range is a densifier motor load setpoint.

3. The coffee densifier of claim **1**, wherein the controller is configured to signal the discharge door actuator to retract the discharge door a predefined distance to increase the density of the ground coffee exiting the chamber when the densifier motor load is below the densifier motor load operating range.

4. The coffee densifier of claim **1**, wherein the controller is configured to signal the discharge door actuator to open the discharge door a predefined distance to decrease the density of the ground coffee exiting the chamber when the densifier motor load is above the densifier motor load operating range.

5. The coffee densifier of claim **1**, wherein

the densifier motor load operating range is a densifier motor load setpoint;

the controller is configured to signal the discharge door actuator to retract the discharge door a predefined distance to increase the density of the ground coffee exiting the chamber when the densifier motor load is below the densifier motor load setpoint; and,

the controller is configured to signal the discharge door actuator to open the discharge door the predefined distance to decrease the density of the ground coffee exiting the chamber when the densifier motor load is above the densifier motor load setpoint.

6. The coffee densifier of claim **1**, comprising a user input device signal-connected to the controller for allowing a user to define the densifier motor load operating range.

7. The coffee densifier of claim **1**, wherein the controller comprises a startup function configured to position the discharge door in the closed position during a startup of the coffee densifier until the densifier motor load reaches the densifier motor load operating range.

8. The coffee densifier of claim **1**, wherein the controller comprises a cleanout function configured to position the discharge door in the open position after a predetermined time period when no coffee grounds are being added through the inlet.

9. The coffee densifier of claim **1**, wherein the controller is configured to signal the discharge door actuator to move the discharge door between a plurality of positions between a full open position and a full closed position depending on the densifier motor load.

10. The coffee densifier of claim **1**, wherein the controller is configured to signal the discharge door actuator to move the discharge door a predefined distance to increase or decrease each of (a) a rate at which the ground coffee exits the chamber, (b) the densifier motor load, (c) a resident time which the ground coffee is retained in the chamber before exiting, and (d) an amount of coffee chaff in the ground coffee exiting the chamber through the discharge opening.

11. The coffee densifier of claim **1**, wherein the chamber comprises a receiving portion and a densifier portion, the plurality of densifier members are located along the shaft in the densifier portion, a spiral auger is attached to the shaft in the receiving portion and configured to move the ground coffee toward the plurality of densifier members in the densifier portion when the spiral auger is turned by the shaft.

12. The coffee densifier of claim **1**, wherein the plurality of densifier members are a plurality of paddle-less pins.

13. The coffee densifier of claim **12**, wherein the plurality of paddle-less pins comprise four pin rows, each pin row comprising at least two pins of the plurality of paddle-less pins, the four pin rows are spaced about the shaft at ninety degree increments.

14. The coffee densifier of claim **1**, wherein the controller is configured to signal, at regular intervals, the discharge door actuator to move the discharge door to increase or decrease a density of the ground coffee exiting the chamber through the discharge opening when the controller detects the densifier motor load, as reported by the densifier motor load sensor, is outside a predefined densifier motor load operating range.

15. The coffee densifier of claim **1**, wherein the controller is configured to continuously signal the discharge door actuator to move the discharge door to increase or decrease a density of the ground coffee exiting the chamber through the discharge opening when the controller detects the densifier motor load, as reported by the densifier motor load sensor, is outside a predefined densifier motor load operating range.

16. A coffee processor, comprising:

a coffee grinder comprising

at least one grinder motor; and,

at least one pair of grinding rollers driven to rotate by the at least one grinder motor;

a coffee densifier comprising

an elongated chamber configured to receive a ground coffee from the coffee grinder, the chamber having an inlet and a discharge opening, the discharge opening comprising a discharge door, the inlet for receiving the ground coffee;

a densifier motor independent from the at least one grinder motor;

a shaft that is driven to rotate by the densifier motor and extending within the chamber;

a plurality of densifier members fixed to the shaft and configured to polish a plurality of coffee particles of the ground coffee within the elongated chamber when the plurality of densifier members are rotated by the shaft through the ground coffee within the chamber;

a discharge door actuator operatively connected to the discharge door and configured to move the discharge door between an open position, and a closed position, and at least one intermediate position;

a densifier motor load sensor that is signal-connected to a controller and configured to report to the controller a densifier motor load on the densifier motor driving the plurality of densifier members polishing the ground coffee in the chamber; and,

the controller configured to signal the discharge door actuator to move the discharge door to increase or decrease a density of the ground coffee exiting the chamber through the discharge opening when the controller detects the densifier motor load, as reported by the densifier motor load sensor, is outside a predefined densifier motor load operating range.

17. The coffee processor of claim **16**, wherein the at least one pair of grinding rollers comprises a fast roller and a slow roller; a gap is located between the fast roller and the slow roller to allow coffee beans ground between the fast roller and the slow roller to pass through toward the inlet of the coffee densifier.

18. The coffee processor of claim **16**, wherein the densifier motor load operating range is a densifier motor load setpoint.

19. The coffee processor of claim **16**, wherein the controller is configured to signal the discharge door actuator to retract the discharge door a predefined distance to increase the density of the ground coffee exiting the chamber when the densifier motor load is below the densifier motor load operating range.

20. The coffee processor of claim **16**, wherein the controller is configured to signal the discharge door actuator to open the discharge door a predefined distance to decrease the density of the ground coffee exiting the chamber when the densifier motor load is above the densifier motor load operating range.

21. The coffee processor of claim **16**, wherein

the densifier motor load operating range is a densifier motor load setpoint;

the controller is configured to signal the discharge door actuator to retract the discharge door a predefined distance to increase the density of the ground coffee exiting the chamber when the densifier motor load is below the densifier motor load setpoint; and,

the controller is configured to signal the discharge door actuator to open the discharge door the predefined distance to decrease the density of the ground coffee exiting the chamber when the densifier motor load is above the densifier motor load setpoint.

22. The coffee processor of claim **16**, comprising a user input device signal-connected to the controller for allowing a user to define the densifier motor load operating range.

23. The coffee processor of claim **16**, wherein the controller comprises a startup function configured to position the discharge door in the closed position during a startup of the coffee densifier until the densifier motor load reaches the densifier motor load operating range.

24. The coffee processor of claim **16**, wherein the controller comprises a cleanout function configured to position the discharge door in the open position after a predetermined time period when no coffee grounds are being added through the inlet.

25. The coffee processor of claim **16**, wherein the controller is configured to signal the discharge door actuator to move the discharge door a predefined distance to increase or decrease each of (a) a rate at which the ground coffee exits the chamber, (b) the densifier motor load, (c) a resident time which the ground coffee is retained in the chamber before exiting, and (d) an amount of coffee chaff in the ground coffee exiting the chamber through the discharge opening.

26. The coffee processor of claim **16**, wherein the chamber comprises a receiving portion and a densifier portion, the plurality of densifier members are located along the shaft in the densifier portion, a spiral auger is attached to the shaft in the receiving portion and configured to move the ground coffee toward the plurality of densifier members in the densifier portion when the spiral auger is turned by the shaft.

27. The coffee processor of claim **16**, wherein

the at least one pair of grinding rollers comprises a fast roller and a slow roller; a gap is located between the fast roller and the slow roller to allow coffee beans ground between the fast roller and the slow roller to pass through toward the inlet of the coffee densifier;

the controller is configured to signal the discharge door actuator to retract the discharge door a predefined distance to increase the density of the ground coffee exiting the chamber when the densifier motor load is below the densifier motor load operating range;

the controller is configured to signal the discharge door actuator to open the discharge door the predefined distance to decrease the density of the ground coffee exiting the chamber when the densifier motor load is above the densifier motor load operating range;

comprising a user input device signal-connected to the controller for allowing a user to define the densifier motor load operating range;

the controller comprises a startup function configured to position the discharge door in the closed position during a startup of the coffee densifier until the densifier motor load reaches the densifier motor load operating range;

the controller comprises a cleanout function configured to position the discharge door in the open position after a predetermined time period when no coffee grounds are being added through the inlet; and,

the chamber comprises a receiving portion and a densifier portion, the plurality of densifier members are located along the shaft in the densifier portion, a spiral auger is attached to the shaft in the receiving portion and configured to move the ground coffee toward the plurality of densifier members in the densifier portion when the spiral auger is turned by the shaft.

28. The coffee processor of claim **16**, wherein

the coffee grinder comprises

a grinder motor power transducer that reports a real-time grinder motor load being used by the grinder motor,

a grinder inlet above the pair of grinder rollers,

a grinder outlet below the pair of grinder rollers;

the controller comprises a cleanout function configured to position the discharge door in the full open position after a predefined time period has elapsed in which the controller receives a signal from the grinder motor power transducer that the real-time grinder motor load from the grinder motor is outside the predefined mixer motor load operating range;

the inlet of elongated chamber is a densifier inlet; and,

the densifier inlet is located below the grinder outlet.

29. The coffee processor of claim **16**, wherein

the coffee grinder comprises

a grinder motor load sensor that reports a grinder motor load being used by the grinder motor,

a grinder inlet above the pair of grinder rollers, and,

a grinder outlet below the pair of grinder rollers;

the controller comprises a cleanout function configured to position the discharge door in the at least one intermediate position after a predefined time period has elapsed in which the controller receives a signal from the grinder motor load sensor that the grinder motor load from the grinder motor is outside the predefined mixer motor load operating range;

the inlet of elongated chamber is a densifier inlet; and, the densifier inlet is located below the grinder outlet.

30. A coffee densifier, comprising:

an elongated chamber, the chamber having an inlet and a discharge opening, the inlet for receiving a ground coffee into the chamber;

a discharge door adjacent the discharge opening for selectively blocking the discharge opening;

a densifier motor;

a shaft that is driven to rotate by the densifier motor, the shaft extends within the chamber;

a plurality of densifier members extending from the shaft and configured to polish a plurality of coffee particles of the ground coffee within the elongated chamber when the plurality of densifier members are rotated by the shaft through the ground coffee within the chamber;

a discharge door actuator connected to the discharge door and configured to move the discharge door between an open position, and a closed position, and at least one intermediate position;

a controller;

a densifier motor load sensor that is signal-connected to the controller and configured to report to the controller a densifier motor load on the densifier motor driving the plurality of densifier members polishing the ground coffee in the chamber;

the controller configured to signal the discharge door actuator to move the discharge door to increase or decrease a density of the ground coffee exiting the chamber through the discharge opening when the densifier motor load sensor reports the densifier motor load is outside a predefined densifier motor load operating range.

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